
QPC71 E&M/DX and Paging Trunk Card

Introduction

The QPC71 E&M/DX and Paging Trunk Card is a peripheral equipment (PE) device that can be installed in any peripheral shelf or NT8D13 Peripheral Equipment (PE) Module. The E&M/DX and paging trunk card interfaces two analog trunk lines to the Meridian 1 switch. Each trunk is independently configurable using the Trunk Administration Program (LD 14).

The E&M/DX and paging trunk card supports these trunk types:

- E&M signaling, 2-way dial repeating trunk
- 2-wire DX signaling, 2-way dial repeating trunk
- 4-wire DX signaling, 2-way dial repeating trunk
- Paging trunk, dial access or attendant access via the press-to-talk key

Physical description

The E&M/DX and paging trunk card mounts in any PE slot. The two trunk circuits and common multiplexing circuitry are mounted on a 31.74 cm by 25.4 cm (12.5 in. by 10 in.) printed circuit board.

The E&M/DX and paging trunk card connects to the backplane through an 80-pin connector shroud. The backplane is then cabled to the input/output (I/O) panel that is cabled to the main distribution frame (MDF) by 25-pin cables. Trunk lines connect to the card at the MDF. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross connect information.

The faceplate of the card is equipped with a red light emitting diode (LED) (see [Figure 54](#)). The LED should only be lit when the board is defective. If the LED operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

Functional description

[Figure 55](#) shows a block diagram of the major functions contained on the E&M/DX and paging trunk card. Each of these functions is described on the following pages.

Card interfaces

The E&M/DX and paging trunk card passes both voice and signaling data over the network loop. SL-1 network loops are discussed in detail in “Peripheral equipment” on page 22.

Trunk interface units

The E&M/DX and paging trunk card contains two identical and independently configurable trunk interface units (also referred to as circuits). Each unit provides impedance matching and a balance network in a signal transformer/analog hybrid circuit. Also provided are relays for placing outgoing call signaling onto the trunk. Signal detection circuits monitor incoming call signaling.

Two codecs are provided for performing A/D and D/A conversion of trunk analog voiceband signals to digital PCM signals. Each codec supports one trunk interface unit. The following features are common to all units on the card:

- trunk type configurable for each unit
- balanced terminating impedance (600 or 900 ohm, selectable at the MDF) on a per unit basis
- E&M signaling
- DX signaling bridge for 2-wire or 4-wire mode of operation (bridge balancing is not required; however, conductor loop range compensation is made via the eight-switch option pad)
- supervision of far-end off hook and dial pulsing

Figure 54
E&M/DX and paging trunk card—faceplate

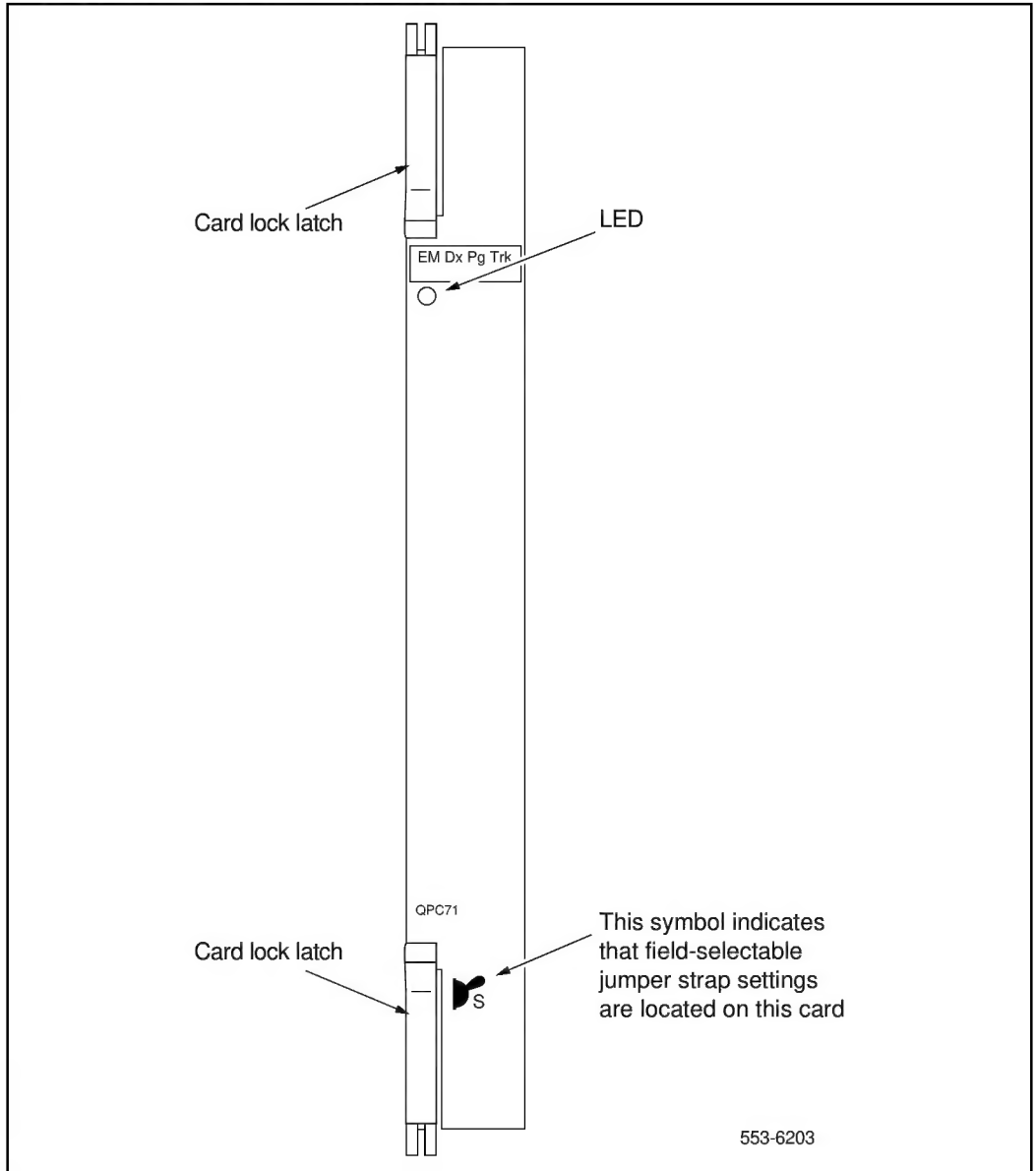
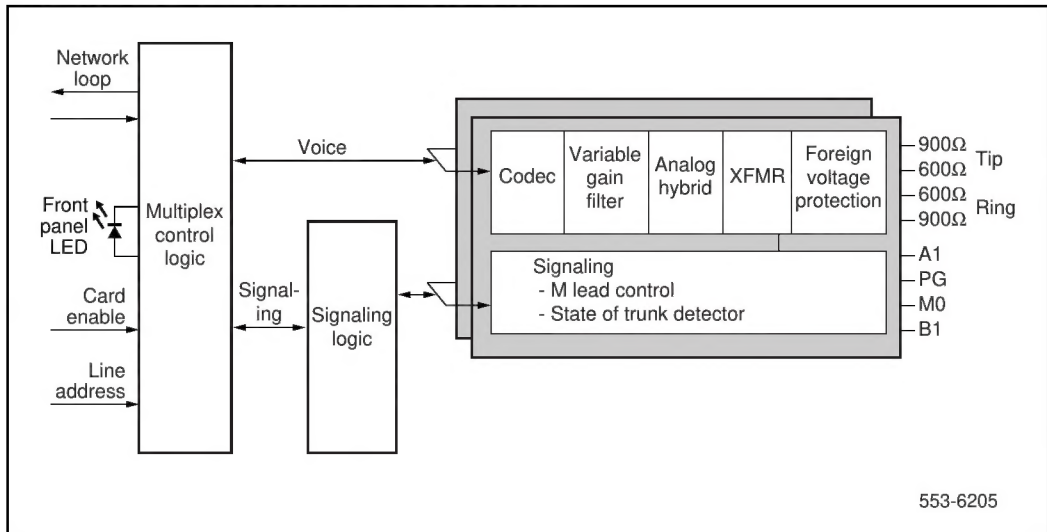


Figure 55
E&M/DX and paging trunk card—block diagram



- near-end seizure and outpulsing via the M lead when in E&M mode, and via the A1 lead when in DX mode
- isolation of foreign potentials on the loop from portions of the transmission and signaling circuit
- external 2-wire to internal 4-wire conversion of the transmission path via hybrid transformer
- controlled false detection compensation on outpulsing
- switchable 2-dB pad for controlling gain between line-to-trunk and trunk-to-trunk on normal non-VNL connections, and gain and echo protection on VNL through balance and terminal balance connections

Multiplex control

The multiplex control logic is common to both channels. This logic interfaces the individual trunk circuits to the peripheral bus signaling channel. Circuits are provided in the multiplex control logic to retiming the digital signals received from the peripheral bus. Other circuits decode the address information contained on the peripheral bus to enable the individual trunk circuits during their selected time slots. Logic is also provided to enable or disable the front panel LED to indicate the service state of the card. The multiplex control logic is discussed in detail in "Peripheral equipment" on page 22.

Operation

The optional applications, features, and signaling arrangements for each unit on the E&M/DX and paging trunk card are assigned through the Trunk Administration (LD 14) and Trunk Route Administration (LD 16) programs and/or jumper strap settings on the card. See the *X11 input/output guide* for detailed information on assigning features and services to trunks.

The two release control options available are: EITHER or ORIGINATING party control. These can be specified for the Meridian 1 system end (near end), or for the CO or other PBX end (far end). Joint party control can also be specified for the far end.

Idle circuit states**Trunk is idle**

No current flow in signaling lead for DX. State of trunk detector is high. For E&M signaling, M lead is ground and E lead is open circuit.

Trunk cards are scanned periodically by the common equipment (CE). A trunk circuit receives its card enable in time slot 0. The signaling logic responds with a signal on the data input bus.

Outgoing calls

Origination of call

A Meridian 1 switch seizes a trunk facility by sending a message to the trunk circuit signaling logic causing K1 relay to operate. The M lead changes from ground to battery in E&M; or from no current flow to current flow in A1 lead for DX signaling.

The signaling logic responds to the enable with a signal on the data input bus. The scan stops and the card receives further enables. The signaling logic also receives signals on the data output bus and, on receipt, will output contents of the input register onto the data input bus, thus reporting change of state. The scan cycle will then continue.

When ready for outpulsing, a trunk outpulsing enable is sent in an assigned timeslot (not timeslot 0 or timeslot 1) and a message is sent to the signaling logic to set up the trunk logic such that K1 is now controlled by the signal level of the data output bus in the assigned timeslot.

The common equipment (CE), by sending the appropriate data in the selected timeslot, causes K1 to outpulse the required digits. (See [Tables 26, 27, and 28](#) for DX signaling, and [Figures 56 and 57](#) for E&M.)

At the completion of outpulsing, another message is sent to the signaling logic that restores control of K1 to the signaling logic, and the enable in the assigned timeslot is removed.

If answer supervision is provided by the far end, there will be a change from open to ground on the E lead (ground detection) for E&M signaling, or from current flow to no current in the A1 lead (bridge unbalance detection) DX. The signaling logic will subsequently report change of state to the CE.

Disconnection

Disconnection is caused by near end control trunk release.

See [Tables 26 through 28](#) for DX signaling and [Figures 56 and 57](#) for E&M signaling.

Table 26
DX signaling for outgoing calls, originating party release

Condition	Current in signaling lead	State of trunk detector input to signaling logic
Idle	no current flow	high
Seizure (dial tone from far end; far end ready for digits)	current flow	high
Digits	current flow interrupted for each pulse	high
Far end answers	no current flow	low
Far end on hook first	current flow	high
Network taken down and trunk idled when near end goes on hook;	no current flow	high
Near end on hook first, network taken down	current flow	low
Far end on hook trunk idled	no current flow	high

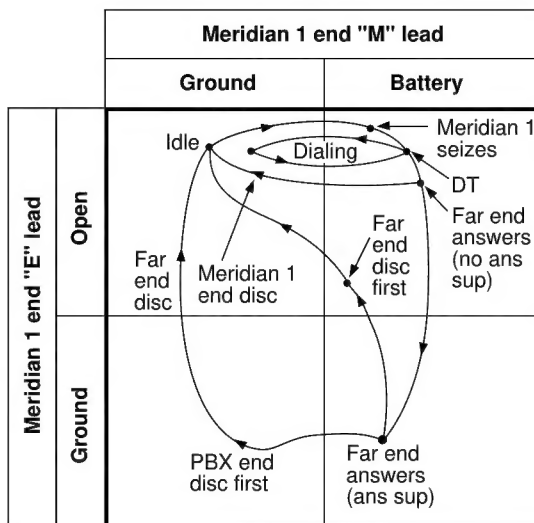
Table 27
DX signaling for incoming calls, originating party release

Condition	Current in signaling lead	State of trunk detector input to signaling logic
Idle	no current flow	high
Seizure (dial tone to far end; near end ready for digits)	current flow	low
Digits	current flow interrupted for each pulse	low-high-low for each pulse
Near end answers	no current flow	low
Far end on hook first	current flow	high
Network taken down and trunk idled	no current flow	high
Near end on hook first, network taken down	current flow	low
Far end on hook trunk idled	no current flow	high

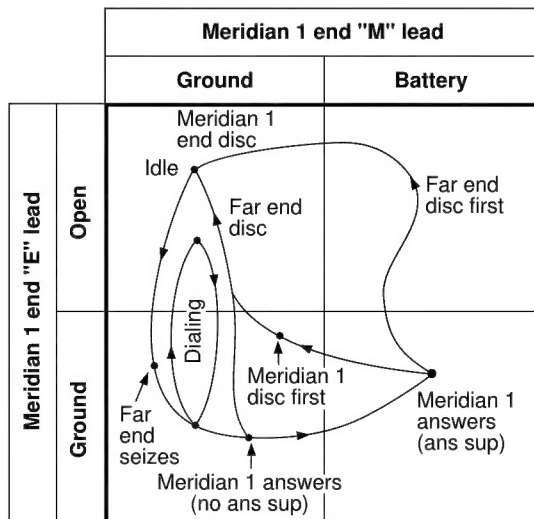
Table 28**DX signaling, originating party release on tandem connections, outgoing calls**

Condition	Current in signaling lead	State of trunk detector input to signaling logic
Idle	no current flow	high
Seizure (far end ready for digits)	current flow	high
Dial CO/FX/WATS	current flow interrupted for each pulse	high
Stop sender	no current flow	low
Go sender (universal service provided by far end PBX if originating end is senderized)	current flow	high
(CO/FX/WATS offices ready for digits)		
Stored office DN digits	current flow interrupted for each pulse	high
Outpulsed	no current flow	low
Far end answers	no current flow	low
Far end on hook first	current flow	high
Near end on hook, network taken down, trunk idled	no current flow	high
Near end on hook first, network taken down	current flow	low
Far end on hook trunk idled	no current flow	high

Figure 56
E&M lead signaling patterns, originating party release



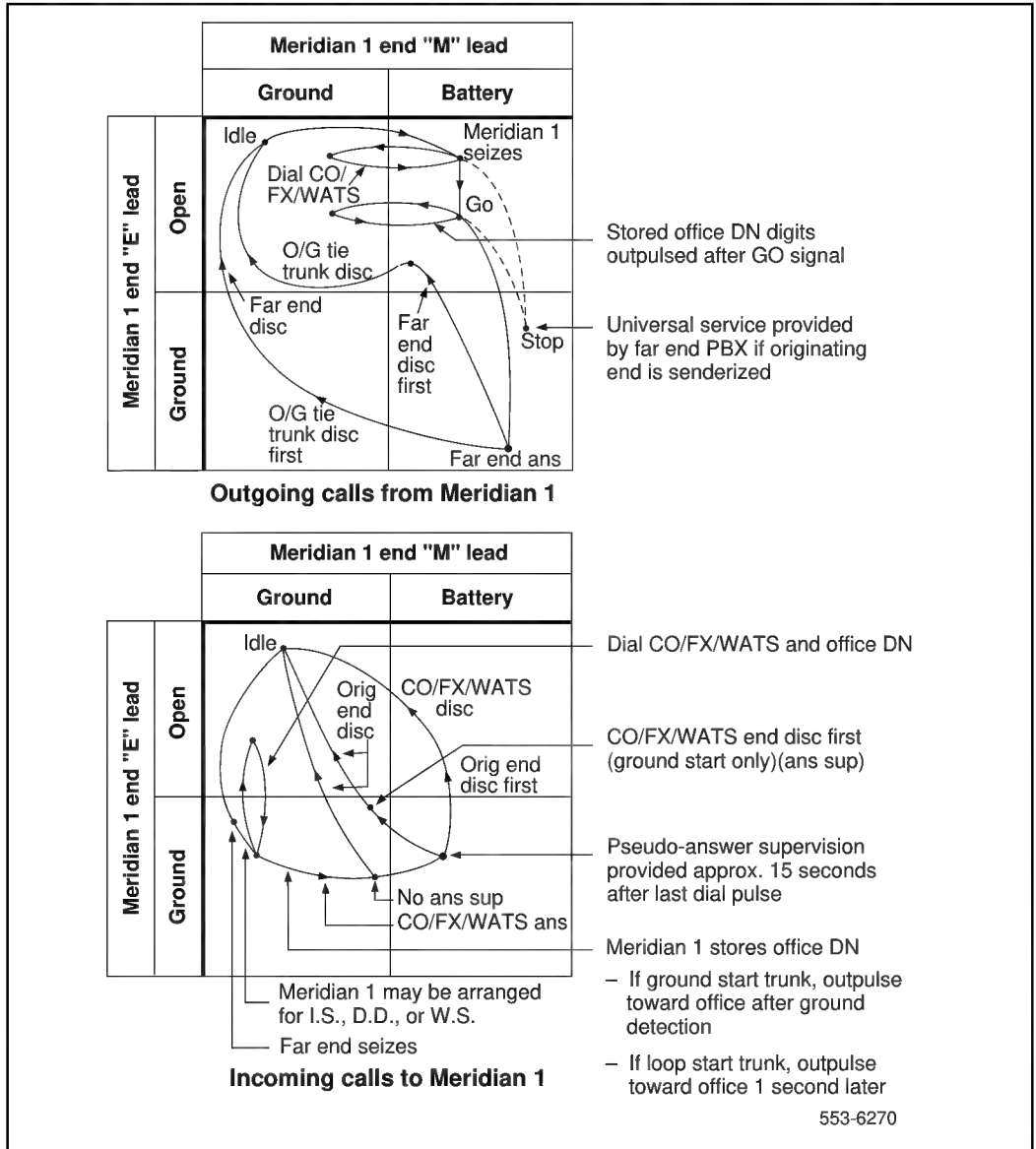
Outgoing calls from Meridian 1



Incoming calls from Meridian 1

553-6269

Figure 57
E&M lead signaling patterns, originating party release on tandem connections



Incoming calls

Origination of call

The far end initiates the call.

During a change of state, ground is placed on the E lead in E&M signaling, or current flow in A1 lead for DX. The appropriate signaling logic input is changed from high to low. A card enable response on the data input bus stops the scan until a change of state is reported to CE.

Dial pulses are subsequently applied from the far end in the form of ground-open on the E lead, or current flow/no current flow in the A1 lead (interruptions). These are detected as changes of state at the signaling logic input.

When the call is completed and the terminating party answers, relay K1 is operated as a result of a message from the CE to the signaling logic, causing the appropriate signal on the M or A1 leads.

If the far end is senderized, the Meridian 1 may be operated in any mode; immediate start, delay dial, or wink start, as assigned on a class of service basis. The class of service modes are shown in [Table 29](#).

Table 29
Class of service modes

Operation	Class of Service
Immediate start	IMM
Delay dial "A"	IMM
Delay dial "B"	DDL
Wink start	WNK

For immediate start class of service (COS), following the seizure signal the far end can start pulsing after the distant end controlled standard delay (normally 70 ms minimum). For stop/go signaling, following the seizure signal, almost immediately an off hook/on hook (320 ± 64 ms for delay dial, 256 ± 64 ms for wink start) signal will be returned to the distant end to satisfy delay dial or wink start mode.

The distant end detecting this signal may start pulsing after the distant end controlled standard delay (normally 70 ms minimum).

When delay dial “B” or wink start COS is used, outgoing calls require stop/go signal from the far end, otherwise the trunk cannot outpulse.

Disconnection

The trunk is released by a disconnect message to the signaling logic that causes K1 to release.

Transmission

Talking connection

Audio signals received from the card tip and ring terminals are passed via the hybrid transformer to the low-pass filter hybrid analog-to-digital filter, then through the PCM codec to the CE for switching. The codec encodes the analog input to produce a digital signal on the data input bus.

Signals received from the common multiplexing circuitry on the data output bus into the codec are decoded to produce the codec analog output. The analog signal from the codec is connected to the input of the low-pass digital-to-analog filter. This circuit integrates the amplitude modulated pulses from the codec, filters the result, and amplifies the analog signals for connection to the hybrid transformer, and through the transformer to the ring and tip leads.

Paging

When used in a paging application, the circuit is connected to a customer-provided paging amplifier system. Connection of the E&M/DX and Paging card to a paging amplifier system is discussed in [“Applications” on page 144](#).

When accessed via dialing or the attendant press-to-talk key, a message is sent to the signaling logic on the circuit causing K1 to be operated. This action causes a loop closure across control leads A1 and PG via a K2 make-contact to operate a customer-provided system. A typical use of this circuit is cutting off music and switching over the paging trunk transmission path to the input of the paging amplifier. The attendant’s paging key has a Preempt feature; that is, by the use of this key, the attendant can access a busy trunk and usurp the current user.

To release the trunk a disconnect message is sent to the signaling logic. This causes K1 to release.

Trunk signaling conditions

Figure 56 on page 128 shows the various states that the trunk card interface goes through under E&M signaling conditions during originating party release when the route does not involve a CO/FX/WATS trunk. Figure 57 on page 129 shows the states that the trunk card interface goes through under E&M signaling conditions during originating party release on tandem connections. These conditions apply when the originating end is senderized and the route is via a CO/FX/WATS trunk. It is not applicable to CCSA lines.

[Table 26, “DX signaling for outgoing calls, originating party release,” on page 125](#) shows the various states that the trunk card interface goes through under DX signaling conditions during originating party release for an outgoing call. [Table 27, “DX signaling for incoming calls, originating party release,” on page 126](#) shows the various states that the trunk card interface goes through under DX signaling conditions during originating party release for an incoming call. [Table 28, “DX signaling, originating party release on tandem connections, outgoing calls,” on page 127](#) shows the various states that the trunk card interface goes through under DX signaling conditions during originating party release on tandem connections for an outgoing call. [Table 30](#) shows the various states that the trunk card interface goes through under DX signaling conditions during originating party release on tandem connections for an incoming call.

Table 30
DX signaling, originating party release on tandem connections, incoming calls

Condition	Current in signaling lead	State of trunk detector input to signaling logic
Idle	no current flow	high
Seizure (Meridian 1 may be arranged for IS, DD, or WS) (near end ready for digits)	current flow	low
Dial CO/FX/WATS & office DN Stored digits outputted on CO/FX/WATS trunk after ground detection if ground start, but after 3 seconds if loop start	current flow interrupted for each pulse	low-high-low for each pulse
If ANS SUP, pseudo-answer supervision is sent approximately 13 seconds after last dial pulse received	no current flow	low
If NO ANS SUP	current flow	low
CO end disconnects (CO ground start—trunk idled and network taken down, but incoming tie trunk held under control of originating end)	current flow	low
Originating end disconnects—network taken down and trunk idled	no current flow	high

Electrical specifications

This section gives the electrical specifications for the E&M/DX and paging trunk card.

Trunk interface electrical characteristics

[Table 31](#) gives the electrical characteristics for the trunk interface units on the E&M/DX and paging trunk card.

Table 31
Trunk interface electrical characteristics

Characteristic	Specification
Circuits per card	2
Nominal impedance	600 or 900 ohms
Signaling	E&M or DX (2- or 4-wire)
DX loop resistance	less than or greater than 2500 ohms
Paging equipment interface	optional
Line leakage	>30 k Ω
DX loop range	5 k Ω with ± 20 V ground potential difference; far-end battery -42.75 V through -52.5 V

Overload level

Signal levels exceeding +5 dBm applied to the tip and ring will cause distortion in the signal.

Power requirements

[Table 32](#) lists the power requirements for the E&M/DX and paging trunk card.

Table 32
Power requirements

Voltage	Tolerance	Current (max.)
+10.0 V dc	±5 %	30 mA.
−10.0 V dc	±5 %	30 mA.
+6.0 V dc	±1 %	80 mA.
−6.0 V dc	±1 %	80 mA.
−48 V dc	±12 %	350 mA.

Foreign and surge voltage protections

When telephone lines connected to the trunk circuit are exposed to foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protection devices must be installed on the customer's premises. These devices must be capable of providing a path to ground from tip and ring for foreign voltages that exceed 600 V peak.

Environmental specifications

[Table 33](#) lists the environmental specifications for the E&M/DX and paging trunk card.

Table 33
Environmental specifications

Parameter	Specifications
Operating temperature	0° to +60° C (+32 to +140° F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	−40° to +70° C (−40° to +158° F)

Connector pin assignments

The E&M/DX and paging trunk card brings the analog trunks to the PE backplane through an 80-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

Telephone trunks connect to the E&M/DX and paging trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 58](#), and a list of the connections to the E&M/DX and paging trunk card is shown in [Table 34](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

Figure 58
E&M/DX and paging trunk card—typical cross connection example

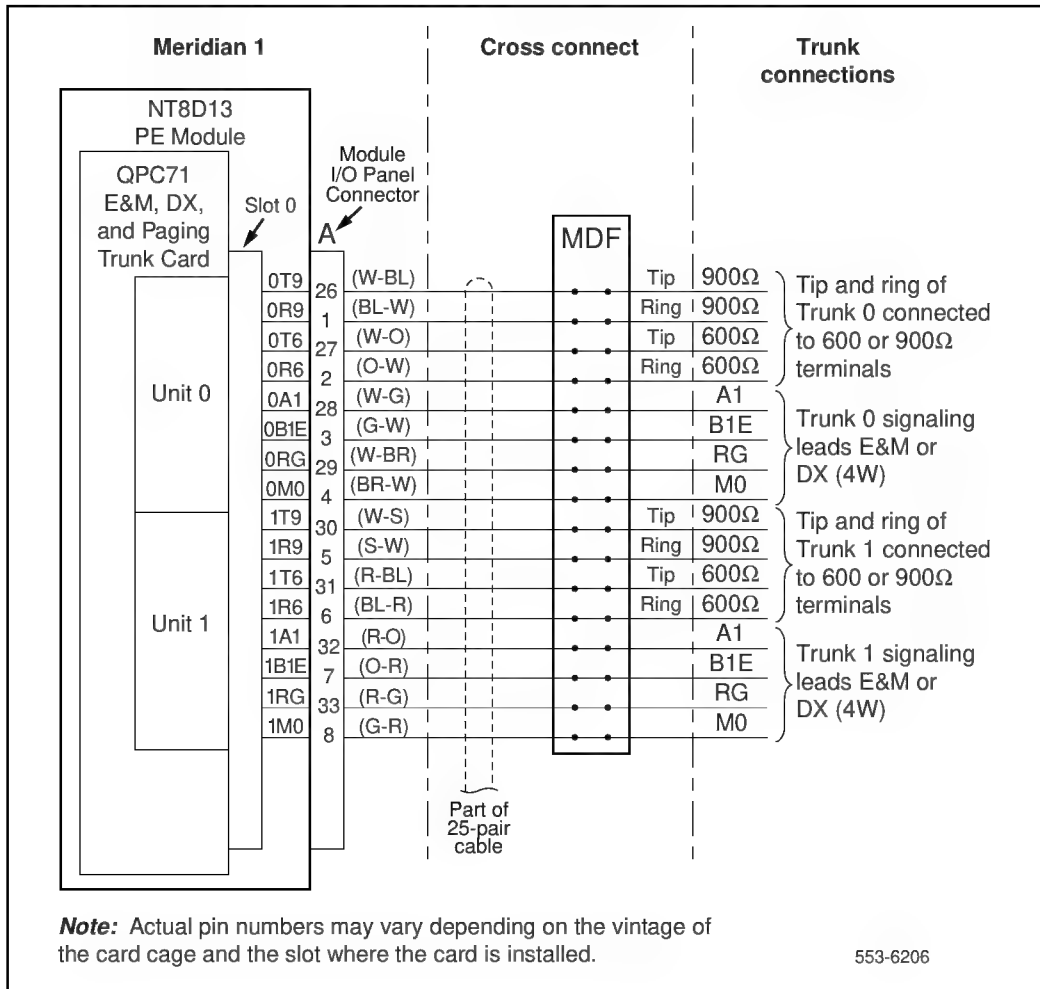


Table 34
E&M/DX and paging trunk card—backplane pinouts

Connector Pin	Signal	Unit
36A	Tip, 900Ω	0
37A	Ring, 900Ω	
38A	Tip, 600Ω	
39A	Ring, 600Ω	
29A	Signaling Lead A1	
30A	Signaling Lead B1E	
32A	Signaling Lead M	
2A	Tip, 900Ω	1
3A	Ring, 900Ω	
4A	Tip, 600Ω	
5A	Ring, 600Ω	
9A	Signaling Lead A1	
10A	Signaling Lead B1E	
12A	Signaling Lead M	

Configuration

The trunk type for each unit on the card as well as its terminating impedance and balance network configuration is selected by software service change entries at the system terminal and by switch settings on the card. The locations of these switches are shown in [Figure 59](#).

Switch settings

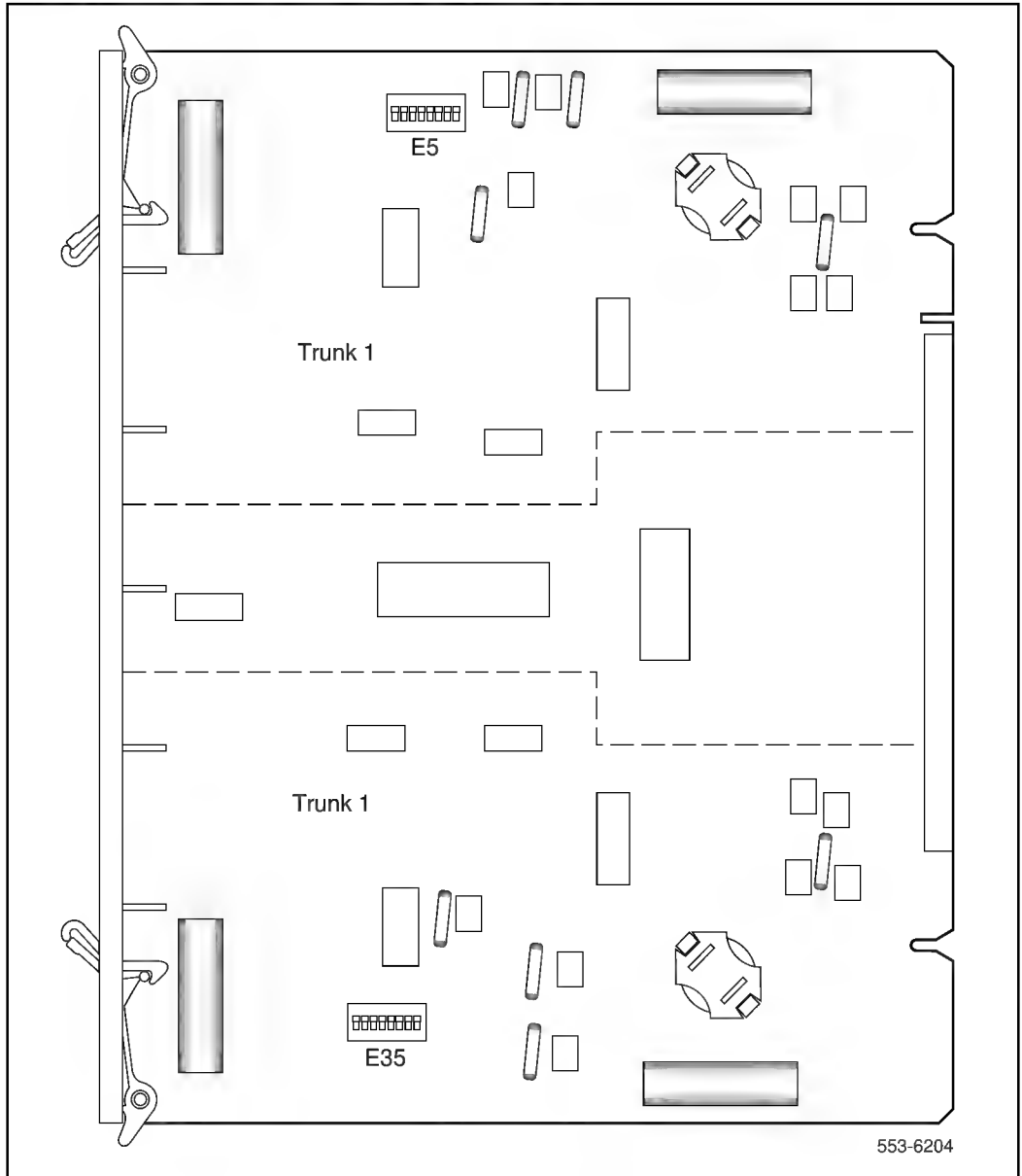
The option switches for each trunk line must be set to select the trunk type. If the trunk type is set to DX, then the conductor loop resistance must also be set. The switch settings are shown in [Table 35](#).

Table 35
E&M/paging trunk card—option switch settings

Trunk 0 and 1 options	Switches							
	1	2	3	4	5	6	7	8
E&M	on	on	on	off	on	on	off	on
DX 2-wire (conductor loop resistance <2.5 kΩ)	off	off	on	on	on	off	on	off
DX 2-wire (conductor loop resistance >2.5 kΩ)	off	off	off	off	on	off	on	off
DX 4-wire (conductor loop resistance <2.5 kΩ)	on	on	on	on	off	off	on	off
DX 4-wire (conductor loop resistance >2.5 kΩ)	on	on	off	off	off	off	on	off
Paging	on	on	on	on	on	on	on	on
Note: DX trunks will not work properly unless they are balanced at the far end. e.g., If the conductor loop <2.5 kΩ, the far end balancing resistor is standard. If the conductor loop >2.5 kΩ, the far end balancing resistor is standard plus 2.5 kΩ. However, when connecting an SL-1 to an SL-1, the option switches should be set for <2.5 kΩ at one end and >2.5 kΩ at the other end. Also use a similar treatment when connecting to a pulse J69 trunk.								

Switch E35 is used to select the trunk type for Trunk 0, and switch E5 is used to select the trunk type for Trunk 1.

Figure 59
E&M/DX and paging trunk card—switch locations



Service change entries

The trunk type, features, signaling arrangement, and insertion loss for each trunk are selected by making service change entries in the Trunk Administration program (LD 14). Refer to the Meridian 1 *X11 input/output guide* for LD 14 service change instructions.

Note: When assigning this card in LD 14, both trunk interface units on the card must have an identical entry for the prompt SIGL, regardless of the application (tie, PAG, etc.). When used as a paging circuit, SIGL should be assigned as one of eam, dx2, or dx4.

Insertion loss

The transmission properties of each trunk are characterized by class of service (COS) assignments included in the trunk data block. The assignments can be either:

- Via Net Loss (VNL)
- non-VNL, either transmission compensated (TRC) or non-transmission compensated (NTC)

To ensure stability and minimize echo on long-haul connections, 4-wire tie and CCSA are assigned either COS (a) or (b). Similarly 2-wire, tie, CO, FX, WATS, CCSA, and 4-wire non-VNL facilities are assigned with one of the options in (b).

The TRC and NTC class options given in (b) determine the operation of the switchable pads contained in the trunk circuit cards. They are assigned as follows:

- TRC: for a 2-wire non-VNL trunk facility with a loss of greater than 2 dB or for which impedance compensation is provided; or for a 4-wire non-VNL facility
- NTC: for a 2-wire, non-VNL trunk facility with a loss of less than 2 dB or when impedance compensation is not provided

The control pad switching for the various through connections and the actual loss introduced is given in [Figure 60](#).

Figure 60
Pad switching algorithm

Through connection			Terminal balance		Through balance	
To From			Station lines Attendant lines	Non-VNL		VNL
				Non-transmission compensated (2-wire facility loss <2 dB or not impedance compensated)	Transmission compensated (2-wire facility loss >2 dB or impedance compensated or 4-wire facility)	Tie CCSA 4-wire
Legend						
IN	Pad switched IN					
OUT	Pad switched OUT					
NA	Not applicable					
Station lines Attendant lines			NA (5)	OUT (1)	OUT (1)	IN (3)
Terminal balance	Non-VNL	Non-transmission compensated (2-wire facility loss <2 dB or not impedance compensated)	NA (1)	IN (1)	IN (1)	IN (1)
			OUT (1)	IN (1)	IN (1)	IN (1)
		Transmission compensated (2-wire facility loss <2 dB or impedance compensated or 4-wire facility)	NA (1)	IN (1)	IN (1)	IN (1)
			OUT (1)	IN (1)	IN (1)	IN (1)
Through balance	VNL	4-wire Tie CCSA	NA (3)	IN (1)	IN (1)	IN (1)
			IN	IN	IN	NA

Note 1: Actual loss (dB) for each connection is given in parentheses.

Note 2: All trunks have an effective gain of 1.5 dB and contain 4 dB switchable pads except for the QPC71 which has 2 dB switchable pads.

Note 3: The Meridian 1 controls the overall connection to connection gain.

553-6273

Applications

Signaling interface

To assist you in connecting the E&M/DX and paging card to different trunk types, [Figure 61](#) shows a simplified schematic diagram of the DX bridge (2-wire/4-wire) signaling, E&M signaling, and paging interface circuit.

[Figure 62](#) shows a simplified schematic of a complete DX signaling circuit.

Figure 61
Simplified schematic of DX bridge signaling/E&M signaling and paging interface

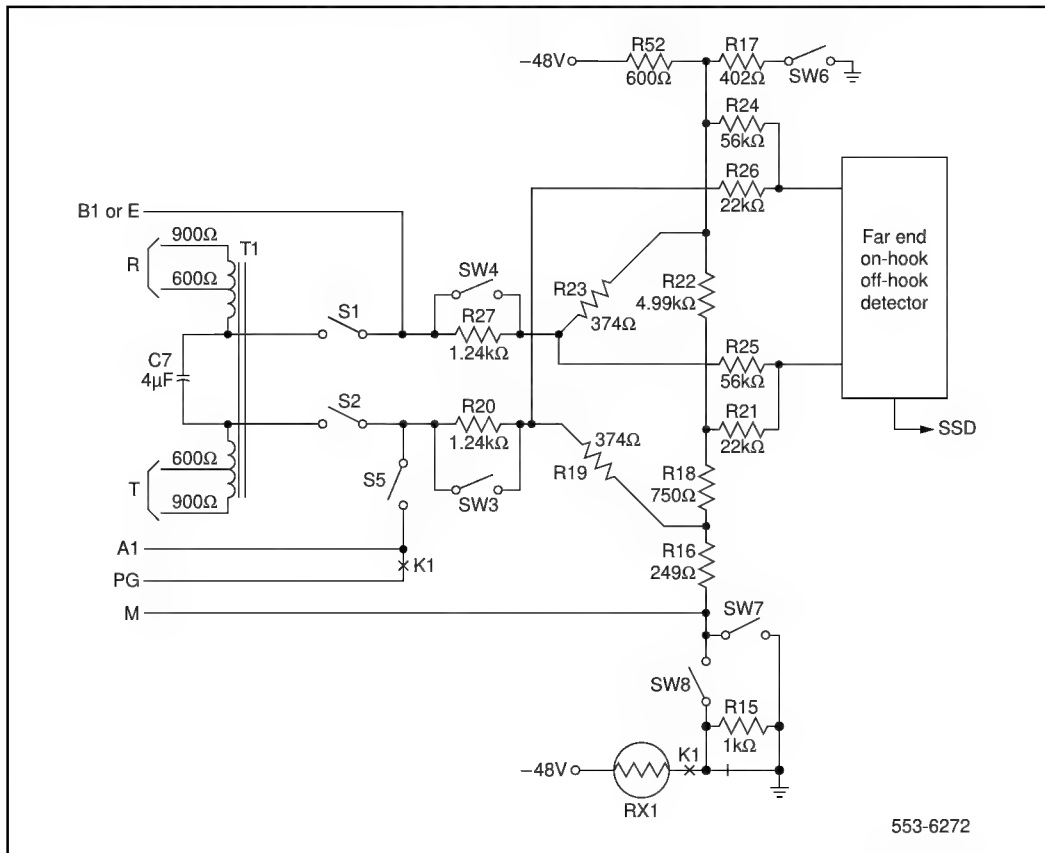
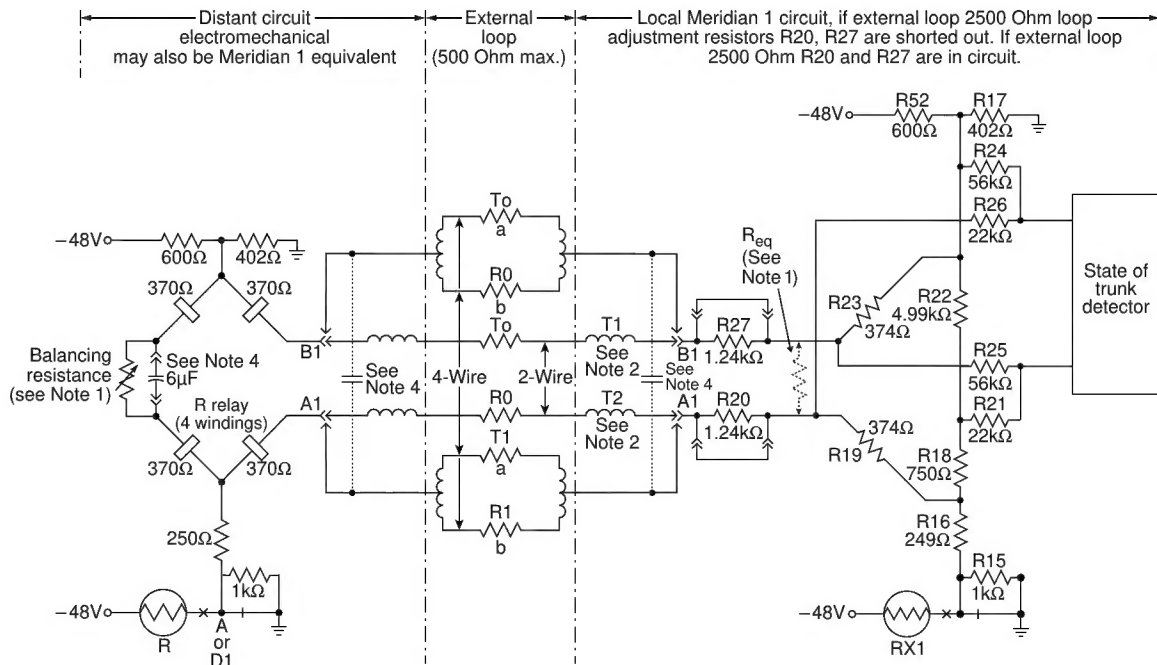


Figure 62
Simplified schematic of DX bridge signaling circuit



Note 1: The equivalent bridge circuit resistance as seen from distant trunk during the signaling is 1250 ± 125 Ohms.

Note 2: T1 resistance is 36 Ohms for 900 Ohm termination option, 26 Ohms for 600 Ohm termination option.

Note 3: Compute total balancing resistance as follows (note that in some new DX circuits, a 1260 Ohm resistor is permanently wired in series with the selectable resistance).

Total balancing $R = \text{external loop resistance} + 2 \times \text{T1 resistance (for 2-wire operation only)} + [(R27 + R20) \text{ if not shorted out}] + R_{eq}$.
Resistance of transformers at electromechanical end is low and can be ignored.

Note 4: When the Meridian 1 is connected to an electromechanical trunk using a 4-wire operation, a 4 microfarad capacitor must be connected from the A1 to B1 lead at each end of the trunk (one of these capacitors may already be installed at the electromechanical end) so it is recommended that a 6 microfarad capacitor be connected in series with the balancing resistance.

Note 5: When the Meridian 1 is connected to Meridian 1 or pulse and external loop resistance is 2500 Ohms, the loop adjustment resistors must be shorted out in one machine. If 2500 Ohms, the loop adjustment resistors must be shorted out in both machines.

553-6319

Paging operation

The circuit shown in [Figure 63](#) should be used when connecting the E&M/DX and paging card to a paging system. When accessed via dialing or the attendant press-to-talk key, a message is sent to the signaling logic on the circuit that causes K1 to be operated. This action causes a contact on relay K2 to close the loop across control leads A1 and PG. In a customer-provided system, this is used to cut off the music and switch the paging trunk transmission path to the input of the paging amplifier. The attendant's paging key has a Preempt feature. By the use of this key, the attendant can access a busy trunk and usurp the current user.

The Meridian system releases the trunk by sending a disconnect message to the signaling logic that causes K1 to release.

Figure 63
Schematic showing paging system connections

